

Prevalence and predictors of undernutrition in HIV-infected children on antiretroviral therapy in Abakaliki, Southeast Nigeria

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ABSTRACT

Background: The introduction of antiretroviral therapy (ART) to HIV medicine has dramatically improved the quality of care of HIV-infected children, translating to better nutritional status and general well-being. However, many HIV-infected children especially in sub-Saharan Africa, despite being on ART are malnourished. **Objective:** The study was done to determine the prevalence and predictors of undernutrition among HIV-infected children on ART in Abakaliki. **Materials and Methods:** It was a case-control study with a sample size of 220 (110 HIV infected and 110 HIV negative children as controls) aged 2–17 years. Anthropometric indicators expressed in Z scores were used to define malnutrition: Height for age (stunting) and weight for age (underweight) and weight for height (thinness). A structured questionnaire was used to obtain socio-demographic characteristics and drug adherence. **Results:** The prevalence rates of underweight and stunting were 24.5% and 20.0% in HIV-infected children as against the prevalence rates of 10.0% and 6.4% for underweight and stunting, respectively, found in HIV negative children. These prevalence rates were statistically significant ($P = 0.002$ and $P = 0.001$, respectively). Occupation of caregivers ($P = 0.000$, $P = 0.000$), drug adherence ($P = 0.001$, $P = 0.000$), and WHO clinical stages of disease ($P = 0.002$, $P = 0.000$) were statistically significant predictors of the presence of underweight and stunting, respectively, in HIV-infected children on ART. **Conclusion:** The prevalence of undernutrition is high among children on ART. Nutritional support as well as strengthening adherence to ART is strongly advocated as part of routine care in HIV-infected children on ART.

KEY WORDS: Adherence; Nutritional Support; Stunting; Underweight; HIV-infected Children; Antiretroviral Therapy


INTRODUCTION

Nutrition is a critical factor for the maintenance of health, growth, and development in infants and children.^[1] Undernutrition which manifests as underweight and/or stunting, becomes evident when there is inadequate food supply or poor food intake, poor absorption, and utilization during infections or disease with a negative impact on growth and development.^[2,3] HIV-infected children that are

undernourished have faster progression to AIDS compared to well-nourished HIV positive children.^[1]

HIV progressively weakens the immune system by destroying the CD4+ cells. Malnutrition, on the other hand, impairs immunity by reducing the number of cells in the thymus and retarding the development of peripheral lymphoid organs.^[4] This leads to leukopenia, decrease CD4/CD8 ratio and ultimately leading to an increase in the number of immature T-cells in the periphery.^[4] This comorbidity increases susceptibility to opportunistic infections (atypical and persistent pneumonia, topical and systemic fungal infections, and viral and protozoan infections), increased viral replication and rapid disease progression to AIDS.^[5]

Studies among HIV-infected children carried out in parts of Africa by Jesson *et al.*^[6] and Sunguya *et al.*^[7] reported

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prevalence rates of 42% and 22%, respectively. The difference in prevalence rate observed in the two studies may be attributed to highly active antiretroviral therapy (HAART) in the majority of subjects in the study by Sunguya *et al.*^[7]

Diniz *et al.*^[8] reported that HAART improved growth by decreasing metabolic expenditures and improving nutrient absorption. They evaluated HAART associated changes in growth and hospitalization rates over 3 years in 196 HIV-infected children aged 0–12 years. HAART was associated with significant increases in weight and height Z scores in the first 96 weeks of therapy. The efficacy of ART can be jeopardized when the subjects are nonadherent to the drugs. This was consistent with that reported by Weldehaweria *et al.*^[9] and Jerome *et al.*^[10] that observed that HIV-infected subjects who were adherent on ART had higher body mass index (BMI) compared to non-adherent subjects.

Study by Poda *et al.*^[11] reported that 58% and 92% of HIV-infected children studied had food insecurity and inadequate diet, respectively, and may be responsible for the high prevalence rates of undernutrition (77%) and stunting (65%) reported.

There is paucity of data on this subject in Nigeria. Anyabolu *et al.*^[12] in their study among HIV-infected HAART-naïve children aged 2–15 years, reported a prevalence rate of 48.6% for stunting and 58.6% for underweight. They noted that lower social class and severe immunosuppression were significantly related to severe malnutrition. Anyanwu *et al.*^[13] studied malnutrition in HIV-infected children aged 0–18 years in tertiary institution. They reported the prevalence rates of stunting and underweight as 33.7% and 37.1%, respectively, and these were significantly related to socio-economic class and age. Their study did not specify the proportion of participants that were on ART or were HAART-naïve. They did not also consider the possible relationships of malnutrition with drug adherence and clinical stages of disease and hence the need for this study.

Socio-economic classification considers two parameters; education and occupation of caregivers. Majority of the caregivers of HIV-infected children seen in the clinic of Alex Ekwueme Federal University Teaching Hospital Abakaliki (AEFUTHA) did not have any formal education and some educated caregivers were not gainfully employed, hence the authors of this study preferred to assess occupation of caregivers in relation to malnutrition, since occupation of a person directly affects income and consequently food availability.

Severely malnourished HIV-infected children respond poorly to ART.^[14,15] Hence, the need to prevent malnutrition in these subjects cannot be overemphasized. This study is therefore aimed at determining the prevalence and predictors of undernutrition in HIV-infected children on ART in

Abakaliki. It is hoped that findings from this study will assist the health-care providers in counseling and possibly tackling modifiable variables that may influence undernutrition in HIV-infected children on ART.

MATERIALS AND METHODS

The study is a hospital-based case–control study conducted in AEFUTHA, Ebonyi state within 4 months (August 2018–November 2018).

Sample Size

The sample size was estimated using the prevalence rate of 42% reported by Jesson *et al.*^[6] However, the target population of 128, which was the total number of HIV positive children in AEFUTHA that had been regular in clinic attendance in the past 1 year, was taken into cognizance resulting in a sample size of 96. To account for 10% attrition, we used the minimum sample size of 110 for HIV-infected children and 110 HIV negative age and gender-matched children for controls.

Inclusion Criteria for Cases

The following criteria were included in the study:

1. Children ≥ 2 years to 17 years of age
2. Children who tested positive to HIV serology test and have commenced HAART.

Inclusion Criteria for Controls

The following criteria were included in the study:

1. Children between the ages of 2 and 17 years who tested negative to HIV antibody test.

Exclusion Criteria for Both Cases and Controls

The following criteria were excluded from the study:

1. Children < 2 years and > 17 years
2. History of other chronic illness such as diabetics, hemoglobinopathies, chronic liver disease, and pulmonary tuberculosis
3. HAART-naïve HIV-infected children.

Subject Selection

Stratified sampling method was used to select cases and controls. The study participants were divided into sub-groups called strata. Stratum A was made up of females while B was for males. The study participants who met the inclusion criteria and gave informed consent (and assent were applicable for age) were consecutively recruited by convenient sampling technique into the strata until the sample size was reached for both cases and controls.

Ethical Committee Permission

Ethical approval from the Health Research and Ethical Committee of AEFUTHA was sought and obtained before the commencement of the study. The study was explained to parents/guardian and only those who gave informed written consent were included in the study. Assent to the study was obtained from children that were 7 years and above.

A structured questionnaire was used to collect information on biodata, occupation of caregivers and ART adherence. The occupation of caregivers was classed into five groups and socio-economic class grouped into upper and lower classes as described by Oyedeji.^[16] Weight in kilograms was taken using digital SECA® weighing scale. Height in meters was measured using a stadiometer.

Patient self-report of adherence to ART was obtained from questionnaire and is classified into poor <95% and good when it was at ≥95%. Reverse transcription-polymerase chain reaction was used to detect and quantify the amount of HIV RNA in plasma for all HIV-infected children and graded as suppressed when the viral load is <1000 copies/mL and unsuppressed when the viral load is 1000 copies/mL or more.^[1] Results of CD4% for children <5 years and CD4 count for ≥5 years were used to classify subjects into four immunologic stages: Not significant, mild, advance, and severe disease. The clinical state of subjects was classified using the WHO clinical stages.^[1]

Data Analysis

The information obtained on the socio-demographic characteristics of the children, parents' characteristics, and anthropometric measures of children were entered into SPSS version 19. Descriptive statistics of variables were carried out using frequencies and proportions. Chi-square test was used to test the relationship between HIV seropositivity and nutritional status. Test of association was done using linear regression model. The level of significance was $P < 0.05$.

RESULTS

Of the 220 children (110 HIV infected and HIV negative controls) recruited during the study period, 50.0% were males with male to female ratio of 1:1. The majority of the children were of the 7–12 age brackets (56.4%). Most of the cases and controls had caregivers that were unskilled workers, as shown in Table 1. All the cases were on HAART.

A total of 27 (24.5%) of HIV infected are underweight with 17.2% and 7.3% having moderate and severe underweight malnutrition, respectively, while 10% (11/110) prevalence rate was observed in HIV negative children, as shown in Table 2. Furthermore, 22 (20.0%) of HIV-infected children are stunted compared to 7 (6.4%) noted in HIV negative

children. The majority of HIV-infected children had normal height (80.0%) and weight (75.5%). There were significant relationships between nutritional status (weight for age and height for age) and HIV seropositivity, as demonstrated in Table 2.

The mean age of participants studied was 10.1 years, with a range of 2–17 years. The mean weight and height of cases were 30.6 kg and 1.32 m, respectively, as shown in Table 3. The mean of variables seen in HIV-infected children was lower when compared HIV negative children, as depicted in Table 3.

Table 4 shows the summary of the linear regression result of predictors of weight for age as the outcome measure. The coefficients for the occupation of caregivers (0.321), adherence to drug (0.298), and clinical stages of disease (−0.318) are statically significantly different from point 0 having $P = 0.000, 0.001, \text{ and } 0.002$, respectively. Hence, these

Table 1: Distribution of sociodemographics of HIV-infected children with non-infected children

Socio-demographics	HIV status	
	Positive (n=110) (%)	Negative (n=110) (%)
Age (years)		
2–6	17 (15.5)	17 (15.5)
7–12	62 (56.4)	62 (56.4)
>12	31 (28.1)	31 (28.1)
Gender		
Male	55 (50.0)	55 (50.0)
Female	55 (50.0)	55 (50.0)
Occupation of caregiver		
Professional	1 (0.9)	3 (2.7)
Civil servants/businessmen	3 (2.7)	25 (22.7)
Bureaucrat/technicians	7 (6.4)	10 (9.1)
Skilled artisan	38 (34.5)	23 (20.9)
Unskilled worker	61 (55.5)	49 (44.6)
Socioeconomic status		
Upper	21 (19.1)	40 (36.4)
Lower	89 (80.9)	70 (63.6)

Table 2: Relationship between nutritional status and HIV status

Nutritional status	HIV status		P value
	Positive (n=110)	Negative (n=110)	
Weight for age			
Normal	83 (75.5)	99 (90.0)	
Underweight	27 (24.5)	11 (10.0)	0.002
Height for age			
Normal	88 (80.0)	103 (93.6)	0.001
Stunted	22 (20.0)	7 (6.4)	

variables significantly predict weight for age in HIV-infected cases, as depicted in Table 4.

Table 5 shows the summary of the linear regression result of predictors of height for age as the outcome measure. The coefficients for the occupation of caregivers (0.386), adherence to drug (0.373), and clinical stages of disease (−0.412) are statically significantly different from point 0 having $P = 0.000$, 0.000 , and 0.000 , respectively. Hence, these variables significantly predict height for age in HIV-infected cases, as depicted in Table 5.

DISCUSSION

The prominent age bracket in this study was 7–12 years (56.4%) with an equal male to female ratio. The majority of caregivers of cases and controls were unskilled workers

and of lower socio-economic class. The prevalence rate of underweight malnutrition and stunting in HIV-infected children observed in this study was 24.6% and 20.0% compared to 10.0% and 6.4% of underweight and stunting in controls, respectively. HIV-infected children had lower mean weight, height, and BMI when compared to HIV negative children. Poor adherence, occupation of caregiver, and clinical stage of HIV disease were significant predictors to stunting and underweight among HIV-infected children on ART.

The higher prevalence of underweight and stunting in cases of index study compared to controls and lower means of weight, height, and BMI in cases compared to controls may be related directly to the ability of HIV to impair metabolic functions of absorptions and utilization of nutrients and indirectly through poor food intake due to oral thrush and poor appetite and food unavailability. This finding was similar to that reported by Anyabolu *et al.*^[12] and Akintan *et al.*,^[17] who reported a statistically significant difference in prevalence rates of underweight and stunting in HIV-infected children compared to controls. The use of ART in index study may explain the lower prevalence rate of undernutrition when compared to study by Anyabolu *et al.*^[12] that reported prevalence rate of 48.6.0% (stunting) and 58.6% (underweight) among ART naïve children. The use of potent antiretroviral drugs has been shown to have maximal and durable suppression of viral load, restore, and preserve immune function, thereby reducing HIV-related morbidity and mortality.^[14] However, adherence to ART is an important caveat to the effectiveness of ART. In this study, drug adherence had a significantly predicted poor nutritional status.

This corroborated well with that reported by Weldehaweria *et al.*^[9] that observed HIV-infected subjects that are not adherent

Table 3: Distribution of categorical variables of HIV-infected and non-infected children

Variables	Mean	Median	SD	Range
HIV-infected children				
Age	10.1	9.0	4.5	2–17
Weight (kg)	30.6	26.0	12.7	12–67
Height (m)	1.32	1.29	14.6	84–168
BMI	16.8	16.5	2.4	13.3–20.6
HIV non-infected children				
Age	10.1	9.0	4.5	2–17
Weight (kg)	34.0	33.2	6.4	11–74
Height (m)	1.38	1.36	5.2	91–178
BMI	17.6	17.4	1.6	15.2–25.1

BMI: Body mass index

Table 4: Summary of the linear regression of predictors of weight for age in HIV-infected children

Dependent variable	Predictors	Standardized β coefficient	t	P -value	Variance (%)
Weight for age	ART regimen	0.026	0.231	0.783	2.3
	Drug adherence	0.298	2.136	0.001	6.4
	Occupation of caregiver	0.321	3.420	0.000	4.2
	Viral load	−0.022	−0.615	0.201	4.5
	Immunologic stage	−0.145	−3.029	0.044	8.8
	WHO clinical stage	−0.318	−2.566	0.002	11.2

ART: Antiretroviral therapy

Table 5: Summary of the linear regression of predictors of height for age in HIV-infected children

Dependent variable	Predictors	Standardized β coefficient	t	P -value	Variance (%)
Height for age	ART regimen	0.065	0.023	0.783	3.2
	Drug adherence	0.373	4.431	0.000	6.8
	Occupation of caregiver	0.386	5.523	0.000	4.8
	Viral load	−0.228	−3.610	0.071	5.2
	Immunologic stage	−2.140	−1.021	0.054	8.7
	WHO clinical stage	−0.412	−4.682	0.000	10.8

ART: Antiretroviral therapy

on ART were 6-times more likely to be malnourished compared to adherent subjects. The occupation of caregivers describes the earning power and take-home package of the caregivers. This directly relates to food availability and food security in the home. More than half (55.5%) of the cases had caregivers who were unskilled workers, and 80.9% of caregivers were of the lower socio-economic class. Consequently, these caregivers had low earning power which may have translated to decreased ability to procure sufficient food for their homes.

This is in consonance with that observed by Poda *et al.*^[11] they noted that increasing income also leads to improvements in nutrition and health status. Lack of access to food and consequently poor food intake worsens the catabolic nature of HIV infection leading to HIV-associated weight loss, which may be recalcitrant even with ART.^[14,15] In this study, the occupation of caregivers, along with the WHO clinical stages of disease were significant predictors of poor weight for age (underweight) and height for age (stunting). This was in tandem with that observed by Sunguya *et al.*^[7]

Strength and Limitation of the Study

There is a paucity of data on the subject matter in Nigeria. It is the only case-control study on HIV-infected children aged 2–17 years on HAART in this locality and also determined the possible predictors of malnutrition in HIV-infected children on ART, unlike other studies. It is however limited in its inability to measure all other possible psychosocial factors that may indirectly influence undernutrition in HIV-infected children on ART such as poor relationship between subject and caregiver, depression, and feeling of stigmatization in the subjects.

CONCLUSION

HIV-infected children on ART were found to have a significantly higher prevalence rate of undernutrition compared to HIV negative children in this study, and this was significantly related to the occupation of caregiver, ART adherence, and WHO clinical stages of disease. Strengthening drug adherence enforcement and nutritional support are recommended as integral aspects of HIV care for all HIV-infected children on HAART.

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